Composting Toilets

According to the Environmental Protection Agency, an average household of four uses about 400 gallons of water each day, and toilet flushing alone can account for over a quarter of that total! Older toilets in particular use large volumes of water to flush, so one way to cut down on household water consumption is to replace less efficient models with low-flow toilets. Another alternative that is gaining in popularity is a composting toilet.

Deluxe composting toilet. Photo credit: Permaculture Association / Flickr

A typical composting toilet is completely waterless, although some types do use a very small amount of water or foam to flush. Unlike traditional toilets that feed into a mixed greywater and blackwater septic system, the waste from composting toilets is processed on-site. Composting toilets require more attention than most homeowners are accustomed to giving their bathroom fixtures, including periodic emptying of the waste collection chamber. Some homeowners find, however, that the extra care is worth it for the resulting decrease in water use, the convenience of having a toilet even in places without water or a septic system, and the potential to produce useful compost material from a waste product.

History

Outhouses and pit toilets were around long before anyone had ever thought of indoor plumbing. Rudimentary composting designs featured outhouses with two waste chambers, one for use and one where decomposition could occur. The first instances of what now would be considered composting toilets were invented in the late 1880s. One such model was patented by Henry Moule in 1860 and was designed to “flush” a small amount of dirt over human waste, all of which would eventually be buried in a garden. Modern composting toilets have come a long way. For instance, Clivus Multrum, the most well-known composting toilet company, was founded in 1939 and now offers toilets for both commercial and residential use, in addition to a variety of accessories to make human waste composting easier and more effective than ever.

How They Work

Most composting toilets are installed directly above their waste collection chambers. Waste is mixed with wood chips, sawdust, or other dry material to soak up moisture and achieve the ideal carbon-nitrogen ratio. Over time and with the correct combination of temperature, drainage, aeration, and ventilation, waste breaks down and drastically decreases in volume. Fully composted human waste can be used in gardens or combined with an outdoor compost pile.

Composition: Waste composts best with a 30:1 carbon- nitrogen ratio. Human waste, especially urine, has a high nitrogen content, which means that carbonaceous material must be added. Sawdust, wood chips, and straw are common choices. Kitchen compost can be added to the same waste chamber, but such food scraps should be supplemented with carbonaceous material as well.

Temperature: Heat speeds up the composting process and kills pathogens in the waste. Decomposition generates heat and compost will be hottest in the center of the pile. A large compost pile retains heat better, so the waste chamber should be large enough for a good amount of compost to collect (but not so large that heat is lost in a big, empty space). If the chamber is too small to get hot enough for quick decomposition or liquid evaporation, a heater may be used.

Drainage: Too much liquid can interfere with composting by cooling waste and hindering aerobic conditions. Some liquid evaporates due to heat in the chamber, but this process may not be sufficient to avoid overly damp compost. Many owners choose to separate urine from feces with a device that fits under the toilet seat or by installing a drain in the bottom of the waste chamber. These solutions

prevent excess liquid from pooling at the bottom of the chamber. Liquid waste can be processed with greywater or diluted with water and used to fertilize plants (if permitted by local codes).

Aeration: Aerobic decomposition is faster and doesn't produce the odors that anaerobic decay does; therefore, waste must have a certain amount of air throughout the pile to maintain aerobic conditions. This can be achieved by mixing/turning the compost or layering coarse materials with the waste so air is trapped in the pile.

Ventilation: Vents and fans pull air into the composting chamber to prevent odor from escaping into the bathroom. They also allow oxygen to enter the waste chamber.

Waste should be allowed to decompose for at least a year before it can be considered safe to use as fertilizer.

Composting Toilet (Wikimedia Commons: Way of Nature Corporation)

Composting Toilet Types

Composting toilets are either connected to a central system or are self-contained units. This consideration largely depends on building layout. Unless waste is to be transported via vacuum pump, a central system should be located directly underneath the composting toilet, usually on the floor below. Owners who want second-floor composting toilets or who want the simplest option in terms of installation should consider self-contained toilets, which have trays or drawers that can be emptied.

Central composting systems often feature a large tank with a sloped bottom that allows waste to slide down as it decomposes. An access door is built in on the lower end of the chamber. Other systems have multiple chambers so that fresh waste is added to one chamber while waste in the other chambers can be at various stages of composting. Some toilets require periodic raking or mixing, which can be done by way of the access door, while others have a handle that can be turned to mix compost. Windows can be incorporated into the waste chamber in order to use solar heat to assist composting.

Some toilets use a few ounces of water or foam to flush waste. This liquid can be helpful in carrying waste if the chamber is not directly below the toilet (up to a 45° angle). This type of toilet looks more like a conventional toilet and needs both electrical and water connections.

A sign in the bathroom may be helpful to alert guests as to how the toilet functions, why there is no traditional flush mechanism, and whether they should add sawdust.

Installation and Maintenance

Commercial composting toilets cost from $1,500 to $8,000 depending on the complexity of the system. (In comparison, traditional toilets range from $100 to $2000. Monthly water bills vary widely by region and season, but the average residential customer in Pittsburgh pays about $50 per month.) Homeowners can also build their own composting toilets and there are numerous designs available online. If recycled materials are used, a composting toilet can be made for little to no cost except the time it takes to build and install.

Sawdust can be added after each fecal deposit or, in an institutional setting, at the end of each day. The toilet exterior should be wiped down as with any other toilet. Composting waste should be well-maintained, which includes keeping an eye on moisture and temperature, mixing as needed, and emptying waste chambers when they fill up. With many central systems, it will likely be about two years after installation that the waste needs to be emptied for the first time, and usually once a year after that. Smaller or self-contained systems may need more frequent emptying.

Since blackwater waste is being handled on-site, some composting toilet owners choose to manage all wastewater themselves and install a greywater system. Greywater is most often recycled for toilet flushing, but if a site has only composting toilets, greywater can also be used as a water source for constructed wetlands or as irrigation for nonedible plants in general.

Advantages

- Water conservation
- Lower monthly water bills
- Reduction of size requirements of wastewater collection system, perhaps even elimination of the need for a septic system
- Generation of nutrient-rich fertilizer

Disadvantages

- Upfront cost of buying a ready-made toilet
- Direct handling of human waste material
- Owner must commit to properly maintaining toilet and compost
- Potential problems with odor, insects, or poor composting

In Commercial Buildings

Commercial building operators may face different legal challenges than homeowners when it comes to waste management. **Projects seeking Living Building status must have a closed loop water system**, meaning all water supply needs must be met on-site and all wastewater must be processed and used on-site. Even buildings that have a greywater processing/recycling system and composting toilets may need a backup sewer line to meet building codes. Simultaneously meeting building regulations and project water goals will require negotiation and possibly added cost (for example, installing a sewer connection even if it will not be used).

In institutional settings, if maintenance staff members add wood chips to toilets each day and process

the compost, composting toilets do not add any inconvenience for the building's occupants and guests. Again, some kind of sign may be helpful to let users know why the toilet looks slightly different from what they normally see.

An increasing number of commercial buildings have successfully incorporated composting toilets into their operations. They are now found in city and state parks, schools (see Bertschi School in Seattle, WA and College of the Atlantic in Bar Harbor, ME), churches (Gloucestershire Churches), and offices (Bullitt Center in Seattle, WA).

Links

- The Humanure Handbook
- EPA Composting Toilet Fact Sheet

Upcoming Events

Summer Soiree 2021
July 22 @ 5:30 pm - 8:00 pm

Mill 19 Building Tour: Solar Innovation at Hazelwood Green
August 3 @ 4:00 pm - 5:30 pm

GPRO Operations and Maintenance Training
August 4 @ 9:00 am - August 6 @ 1:00 pm

WELL Education and Training Series Part 2: WELL 101 Training
August 10 @ 9:00 am - 11:00 am

Erie 2030 District Progress Report Reception 2020
August 10 @ 4:00 pm - 5:00 pm

View All Events

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